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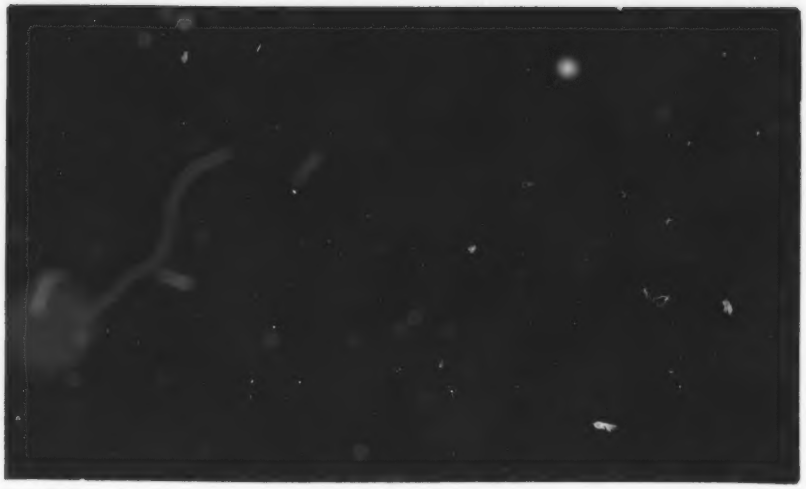

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# RISK POOLING, CONTRACT STRUCTURE AND ORGANIZATIONAL FORM OF INSURANCE FIRMS

by

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## ABSTRACT

Previous explanations of the contract choice and organizational form of insurance firms do not explain, by themselves, the recent proliferation of mutuals and new contract designs. We first present risk bearing arguments to address these phenomena. We present two forms of insurance. The first is a conventional transfer of risk whereas the second decomposes risk between idiosyncratic and non-idiosyncratic. We show that the latter leads to more active trade in insurance markets with correlated exposures. Moreover, the decomposed form dominates the simple transfer. These results qualify and extend the work of Marshall (1984). When the analysis is extended to address agency costs, we are able to derive a richer set of predictions concerning organization and contract choice in insurance markets. Market responses to the recent "liability insurance crisis" are compatible with these predictions.



**Key words** : insurance, contract choice, organizational form of insurance firms, mutuals, liability insurance crisis.


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## RÉSUMÉ

Les explications connues des choix de contrats d'assurance et des formes d'organisation des entreprises ne peuvent pas rationaliser la prolifération récente des mutuelles et des nouvelles formes de contrats. Nous présentons dans une première étape, des arguments de partage des risques pour expliquer ces phénomènes. Nous proposons deux formes d'assurance. Puis nous introduisons des coûts de transaction dans le modèle afin de dériver des prédictions plus complètes sur les formes d'organisation et les choix de contrats. La réaction des marchés privés d'assurance à la crise de l'assurance responsabilité américaine est compatible avec les prédictions du modèle.



**Mots-clés** : assurance, choix de contrats, forme d'organisation des compagnies d'assurance, mutuelles, crise d'assurance responsabilité.

# INTRODUCTION

In recent years, there have been innovations in contract design and organization form that are not easily explained by the existing literature. In liability and earthquake insurance there has been a proliferation of new firms such as mutuals, reciprocals, group captive insurance companies and risk retention groups. For example, Danzon [1985a] documents a dramatic increase in the market share of the mutuals in the medical malpractice insurance market after the mid seventies. A more dramatic example is the pollution insurance market which all but disappeared in 1984-85 only to show some signs of revival with the emergence of "mutual like" pools organized by the major brokers (see Berkowitz [1987]). Similar innovations have also appeared in earthquake insurance. These organization structures share the common feature of combining the equityholder and policyholder functions thereby allocating residual claims on the insurance pool to the policyholders. Risk is pooled amongst those who are commonly exposed rather than transferred to external risk bearers. New policy forms also have been introduced by existing stock insurers. Under "claims made" liability policies, the policyholder is exposed to much of the risk of changing liability rules. This is similar in effect to mutualization.

The various markets in which these innovations have appeared share a common feature. In earthquake insurance, losses are correlated within any seismic zone and risk will not be eliminated by pooling. Liability insurance suffers similar problems of non independence if rules under which liability is determined and damages are assessed change over the life of the insurance contracts. These changes, introduced by legislation or judicial precedent, redefine the insurer's liability for all current policies[1].

The seeds of an explanation for the innovations in contract design can be found in an insightful paper by Marshall written over a decade ago. Marshall [1974] identified two principles under which insurance might function; the reserve, or transfer, principle and the mutualization principle. Under the reserve principle, risk is transferred to external risk bearers to hold in a reserve from which to discharge claims. With mutualization, policyholders jointly hold the residual claims on the pool. Total losses are shared among policyholders by some combination of prepaid premium and retroactive dividend. The reserve principle is efficient when, by the law of large numbers, the average loss is predictable with virtual certainty while the mutualization principle can be used in more general circumstances. More recently, Danzon [1984] has also noted that the formation of mutuals and captives in the medical malpractice insurance market is consistent with the pricing of non independent risks under the risk transfer contracts.

This article first examines alternative contracting arrangements for insuring personal risks when insurance firms are not able to eliminate risk by pooling. The second purpose is to rationalize the emergence of new contract and organization forms in the insurance industry. Two types of contracting are presented. In one arrangement the risk is simply transferred, in full or part, to an external risk bearer. This arrangement is naturally achieved by a stock insurer writing pre-paid insurance policies. In the second arrangement, risk is decomposed into idiosyncratic and non-idiosyncratic risk and separate allocations of these components are made between policyholders and external risk bearers. The alternative arrangements may be viewed in a different light. In the first form, the residual claims on the insurance pool are held by external risk bearers and, in the second, the residual claims are held, at least in part, by the policyholders. This second arrangement can be embodied in the choice of

organizational form for the insurance firm (e.g. a mutual insurance company), in the type of contracts sold (e.g. in a participating policy sold by a stock firm), or in the personal portfolio choices made by individuals (what we later describe as "homemade mutualization").

Basic assumptions and notation are presented in Section II. In section III optimal allocations of risk will be established and compared under the two forms of contracting transfer. Section IV shows that the alternative methods of assembling the respective contracts that may involve simple contract design or choice of organizational form. The comparison between the alternative forms of contracting assumes that the allocation of resources is unaffected by the choice of organization (i.e. the comparison relates only to optimal allocation of risk and abstracts from the role of agency costs). Section V relaxes this assumption and introduces agency considerations in search of a richer set of predictions on insurance contracting.

## II. DEFINITIONS AND ASSUMPTIONS

Consider a group of 'n' individuals, each of whom is exposed to the chance of a random, but insurable, loss. The realized value of the loss of any individual 'i' can be represented as the product of the aggregate loss suffered by the group, L ($=\Sigma L_i$), and the share $a_i$ of that individual in the group aggregate loss;

$$L_i = a_i L \tag{1}$$

The share $a_i$ is a random variable. Ex post, the share of the individual will be zero if (s)he has no loss and can assume many values according to the size of any revealed loss. The properties of the aggregate loss, L, are important. With independence, L/n will converge on a known value with zero variance as 'n' grows larger. The variance of L/n will not converge to zero if losses are heavily correlated.[2] If the aggregate loss is transferred to external investors, it will

command a proportional risk premium.[3]

The economy we envision contains risk averse individuals each having an endowment containing a riskless asset, risky but marketable assets and a risky but non marketable asset. Individuals cannot issue claims on their non marketable assets but they can purchase insurance. The insurable loss is assumed to be uncorrelated with marketable assets in the individual's portfolio.[4]. The loss distributions of insureds are assumed to be identical. When we describe the 'representative' insured, we are describing all insureds.

The economy also contains "investors" who are endowed with a portfolio of marketable assets. Investors may sell insurance in which case they assume residual claims on the insurance pool. They may hold residual claims in an insurance firm selling directly to policyholders or the claims of a firm which reinsures the direct insurer. Alternative insurance arrangements can appear in which external investors play no role, e.g., a simple mutual insurance firm which is wholly owned by its policyholders.

Transaction costs are important in our model. We need to be able to explain why insurance exists. For example, they are necessary to sustain the demand for insurance (infinite transaction costs on non-marketable assets). A goal of the paper is to examine the effects of interdependence on the optimal form of insurance contracting. To keep this focus, we initially assume away agency costs.[5], together with administrative costs[6] and information asymmetries[7]. We will relax these assumptions as we continue into Sections III and IV. Specifically we will show that, absent social risk, some form of transaction cost is necessary to explain why risk premiums exist. In section V, we introduce agency cost arguments in search of a richer theory of organization form and contract choice in insurance markets.

Undiversifiable risk is presented in the simplest manner. Aggregate loss L follows a two point distribution with probabilities p and (1-p);

$$(2) \qquad L = \begin{array}{ll} L^u & (p) \\ L_d & (1-p) \end{array} \qquad \text{where } L^u > L_d$$

The individual will, or will not, have a loss with probabilities q and (1-q). If a loss does arise, it will assume some proportion 'k' of the aggregate loss. Our formulation assumes unlimited liability on the part of the policyholder.

$$(3) \qquad a_i = \begin{array}{ll} 0 & (1-q) \\ k & (q) \end{array}$$

The individual's share of the aggregate loss, $a_i$, is assumed to be independent of the aggregate loss L ($COV(a_i;L)=0$), and the shares of different individuals, $a_i$ and $a_j$, are independent, ($COV(a_i;a_j)=0$). The latter assumption permits us to use the law of large numbers to suggest that the actual number suffering a loss will approach qn as n becomes very large. This implies the following three point distribution for the individual's loss;

$$L_i = \begin{array}{ll} 0 & (1-q) \\ kL^u & pq \\ kL_d & (1-p)q \end{array}$$

The assumptions imply that, in the limit, $k = 1/(qn)$ and $E(a_i) = 1/n$ for all i.

$$(4) \qquad L_i = \begin{array}{ll} 0 & (1-q) \\ L^u/(qn) & pq \\ L_d/(qn) & (1-p)q \end{array}$$

From 4, we see that there is an implied correlation between individual losses, $L_i$. It is straightforward to show that $COVARIANCE(a_iL;a_jL) = E(a_i)E(a_j)VAR(L) \neq 0$.

The respective states of nature are defined in Table 1 :

TABLE 1

| | | aggregate loss (probability) $L^u$ (p) | $L_d$ (1-p) |
|---|---|---|---|
| insured's loss (probability) | 0 (1-q) | State 1 p(1-q) | State 2 (1-p)(1-q) |
| | kL (q) | State 3 pq | State 4 (1-p)q |

## III. A COMPARISON OF ALTERNATIVE INSURANCE CONTRACTS

In the preceding section risk is found in the two state variables $a_i$ and L. Risk arising from the randomness of the $a_i$ is referred to as idiosyncratic risk while we refer to risk inherent in L as dividend risk[8]. This nomenclature recognizes that idiosyncratic risk is diversifiable within the insurance pool but dividend risk typically falls on the pool's owners. Two contracts are defined that may be distinguished in how they address idiosyncratic and dividend risk. Both contracts are routinely encountered in insurance markets. However, while the literature on risk and uncertainty has concentrated on one of these contracts, we will show that the alternative contract is preferred under conditions of dividend risk. The first contract is denoted a simple transfer. The policyholder chooses some proportion, $\alpha$, of his loss to insure:

SIMPLE RISK TRANSFER:

insurance coverage is: $\alpha L_i$ where $L_i = a_i L$

The insurer writing such policies will not be able to eliminate risk through simple diversification within the insurance pool if L is random. It also may be noted that the contract offers only a single decision variable to address an allocation problem in which the state space is described by two state variables. The second contract follows recent finance literature, and decomposes risk

according to the state variables. In this contract, the parties may choose both the proportion of idiosyncratic risk, $\alpha$, and the proportion of dividend risk, $\beta$, that is allocated between the policyholder and the external investors. This resembles many insurance arrangements in which the residual claim is held either by shareholders and/or by policyholders who receive respectively shareholder and policyholder dividends.

DECOMPOSED RISK TRANSFER:

insurance coverage is $\alpha\{[L_i - (1/n)(L-L_d)] + [\beta/n(L-L_d)]\}$

The first square bracket contains only idiosyncratic risk which, in the limit, can be removed by the insurer through diversification. The second square bracket contains the dividend risk. To see this, consider the aggregate payout, AP, for an insurer holding a portfolio of "n" policies:

$$AP = \alpha\{[\Sigma L_i - (L-L_d)] + [\beta(L-L_d)]\}$$
$$= \alpha\{[L_d] + [\beta(L-L_d)]\} \qquad \text{since } \Sigma L_i = L$$

If $\beta$=1, external investors would be left with a portfolio having variance $\alpha^2 VAR(L)$. If $\beta$=0, external investors would bear no risk; the residual claims falling on policyholders. In effect, this would be a simple mutual insurance firm. Moreover, the simple transfer turns out to be a special case of the decomposed transfer. This is seen by setting $\beta$=1 in which case the contracts are identical.

(III.a). Optimal Contracting with Decomposed and Simple Risk Transfers

We first examine decomposed risk transfer, DRT, contracts under the assumption that the distribution of aggregate loss is known by all parties. The DRT contract is an insurance policy which is packaged with a residual claim on the insurance pool. As we stress later, there are various methods of assembling such contracts which may involve the choice of organization form for the insurer,

or the type of contract design chosen by an insurer of a given organization type. The insured pays a premium and receives some proportion $\alpha$ of his individual loss. In addition, the policyholder contracts to bear a proportion $(1-\beta)$ of the dividend risk. The dividend is paid after losses are realized. If insureds bear all dividend risk, $\beta=0$, their total contributions (premiums minus dividends) would equal the aggregate loss in the pool ex post. For example, the insured might prepay a premium equal to his share of the expected aggregate loss, E(L), and receive (pay) a retroactive policyholder dividend should losses be more (less) favorable.[9]:

$$(5) \qquad P = (\alpha/n)(E(L) + (L - E(L))) = (\alpha/n)L$$

However, the contracting arrangements also permit division of the dividend risk between insured and insurer. For example, the DRT might be sold by a mutual firm. The allocation of the dividend risk could then be achieved by controlling the amount of reinsurance purchased by the mutual from an independent reinsurer.[10] The net cost of insurance now comprises an advanced payment equal to the expected loss plus a risk premium R. This risk premium arises from the transfer of a portion $\beta$ of the undiversifiable risk to external investors, thus the advance premium is $E(L)+\beta R$.[11] The dividend to policyholders is now confined to that proportion of the residual claim retained by the policyholders, $(1-\beta)(L-E(L))$. The net cost of insurance is:

$$(6) \qquad P = (\alpha/n)(E(L) + \beta R + (1-\beta)(L - E(L)))$$
$$= (\alpha/n)(L - \beta(L-L_d) + \beta[p(L^u-L_d)+R])$$

The risk premium is required to compensate external investors for bearing undiversified risk. One explanation for a risk premium arises from the pricing of risk in capital markets. If L is correlated with the portfolio of all assets it will command a risk premium in the capital market. Such undiversifiable risk is termed "systematic risk".[12] A second explanation for a premium loading lies

in the presence of firm specific costs of risk bearing. For example, with convex tax functions, the expected tax liability of a firm is positively related to the variance of its pretax income. In the absence of a perfect market for tax arbitrage, the value of the firm will decline as the variance of its pretax income increases unless this risk is priced.[13] A similar story can be told in relation to the transaction costs of bankruptcy and other forms of transaction costs (see Section IV). Either the CAPM or the firm specific cost of risk bearing can be evoked to explain the pricing of risk.

Since the risk premium reflects the market price of risk, the insurer (i.e. its shareholders) is indifferent as to the quantity of insurance sold. The optimal arrangement can be identified by maximizing the expected utility of the representative insured:

$$
\begin{aligned}
(7)\quad EU = {} & (1-q)pU[W - (\alpha/n)\{L^u - \beta(L^u-L_d) + \beta(p(L^u-L_d) + R)\}] \\
& + (1-q)(1-p)U[W - (\alpha/n)\{L_d + \beta(p(L^u-L_d) + R)\}] \\
& + qpU[W - (\alpha/n)\{L^u - \beta(L^u-L_d) + \beta(p(L^u-L_d) + R)\} - (1-\alpha)L^u/(qn)] \\
& + q(1-p)U[W - (\alpha/n)\{L_d + \beta(p(L^u-L_d) + R)\} - (1-\alpha)L_d/(qn)]
\end{aligned}
$$

where U is the insured's utility function and W is endowed wealth. The utility function is assumed to be strictly concave and to satisfy the von Neumann-Morgenstern axioms. The first order conditions are;

$$
\begin{aligned}
(8a)\quad EU_\beta = {} & p[(L^u-L_d)(1-p) - R][(1-q)U_1' + qU_3'] \\
& - (1-p)[p(L^u-L_d) + R][(1-q)U_2' + qU_4'] = 0
\end{aligned}
$$

$$
\begin{aligned}
(8b)\quad EU_\alpha = {} & p[(L^u-L_d)(1-p) - R][(1-q)U_1' + qU_3'] \\
& - (1-p)[p(L^u-L_d) + R][(1-q)U_2' + qU_4'] \\
& + (1/\beta)(1-q)[L^u pU_3' + L_d(1-p)U_4'] \\
& - (1/\beta)(1-q)[L^u pU_1' + L_d(1-p)U_2'] = 0
\end{aligned}
$$

Substituting condition 8a into 8b yields,

(9) $L^u p[U_3' - U_1'] = L_d(1-p)[U_2' - U_4']$

Since wealth in States 3 and 1 differs only by the individual's uninsured loss and wealth in states 4 and 2 also differs by the uninsured loss, the respective square parentheses in equation (9) cannot assume different signs. This follows from monotonicity of the utility function. The only solution is found when $U_3' = U_1'$ and $U_4' = U_2'$ which implies that policyholders fully insure their idiosyncratic risk, i.e., $\alpha = 1$. Thus individuals are indifferent between states 1 and 3 and between states 2 and 4 since their individual loss will be paid by this contract. But this does not imply that all risk is removed. Policyholders still maintain an equity stake in the pool. Dividend risk borne by policyholders is removed only when $\beta$=1.

We now determine the optimal allocation of dividend risk.[14] Since full individual insurance is optimal, ($\alpha$=1), then $U_3' = U_1'$ and $U_4' = U_2'$. Substituting into $EU_B$, yields;

(10) $p(1-p)(L^u-L_d)[U_1' - U_2'] - R[pU_1' + (1-p)U_2'] = 0$

Except in the case in which R=0, satisfaction of this condition requires that $U_1' > U_2'$ which implies $W_1 < W_2$. Thus the individual would retain some dividend risk, $\beta$<1. It will be noticed that the purchase of full direct insurance of idiosyncratic risk ($\alpha$=1) is independent of the R (equation 9). Thus, changes in the cost of external risk bearing will not affect the purchase of insurance against idiosyncratic risk. The individual insurance decision is separable from the dividend decision. This separability arises from the independence of $a_i$ and L in equation (1).

In introducing the SRT and DRT contracts, we showed that the DRT degenerated into the SRT when the value of $\beta$ was constrained to unity. This constraint leaves the SRT with a single control variable, $\alpha$, to span the state space defined by the two state variable, $a_i$ and L. It follows immediately that the SRT cannot be an optimal contract except in the special case that R=0.[15] It is well known from elsewhere[16] that, under a simple risk transfer, the optimal level of insurance is $\alpha^*=1$ if R=0 and $\alpha^*<1$ if R>0.[17] These results can be confirmed easily by setting $\beta=1$ and maximizing eq. (7) with respect to $\alpha$.

Under the DRT, the insured chooses to fully insure idiosyncratic risk but bears part of the dividend risk. How much dividend risk is borne by the policyholder depends upon his/her degree of aversion to risk and on the cost of external risk bearing. In contrast, the SRT presents the insured directly with the external cost of risk bearing when seeking insurance protection. Since this cost entails a proportionate loading in the insurance premium, it induces less than full insurance protection. Thus, insureds participate in their idiosyncratic risk. This comparison suggests that when DRT contracts are traded, there will be a more active market for insurance of idiosyncratic risk than when SRT contracts only are available. The implication is that the DRT form of contract is predicted to appear in insurance markets in which the losses of different policyholders are correlated.

The optimal solutions are illustrated in Figure 1. Consider the DRT. The top part of the figure considers only the determination of $\alpha$ starting with an arbitrary value of $\beta$ such as $\beta=0$ (i.e. the policyholder bears all dividend risk). The axes distinguish only between the loss states 1-2 (in which the individual suffers no loss) and 3-4 (in which a loss is suffered). Position X shows the "no insurance" endowment conditional on L being realized at $L_j$; the co-ordinates

are the wealth levels shown in equation (7) for states 2 and 4 with $\alpha$=0. Similarly, Y shows the wealth endowment if L is realized at $L^u$; thus the co-ordinates are the wealth levels for states 1 and 3 in equation (7) with $\alpha$=0. Since, wealth can be transferred from state 1 to state 3 (and from 2 to 4) at an actuarially fair price, we show the usual fair price lines together with full insurance solutions on the 45 degree line. Note that there are two solutions. With position A the aggregate loss is realized at $L_d$ and a high dividend is paid to policyholders. With position B the aggregate loss is $L^u$ and a low (or no) dividend is paid to policyholders. The difference between A and B reflects dividend risk borne by the policyholder. The solution for $\alpha$ is independent of the dividend decision which is shown in the bottom part of the figure.

INSERT FIGURE 1 ABOUT HERE

The bottom part of the diagram shows the dividend decision which is conditional on the solution, $\alpha^*$=1 for idiosyncratic risk. Position Z shows the wealth co-ordinates for states 1-3 and 2-4 on the assumption that all dividend risk is borne by policyholders. Since an increase in $\beta$ "insures" the dividend risk by transferring it from policyholders to external investors, this can be represented as a wealth transfer between states 1-3 and 2-4. Moreover, since the price of insuring dividend risk is unfair, R>0, the price line will be flatter than the fair price line. The corresponding optimal dividend allocation, $\beta^*$<1, is shown below the 45 degree line. If risk premium R is zero, (e.g. if there is no firm specific cost of bearing risk), the price line will be fair and the optimal $\beta$ will lie on the 45 degree line. Thus all dividend risk would be transferred to external investors. In this case, the DRT offers no advantage over the SRT contract. Marshall, [1974, p484], has made a similar point for the case where aggregate loss is certain.

(III.b) Insurance contracting when the distribution of aggregate loss is unknown

In many insurance markets, there is little data from which to estimate the distribution of the aggregate loss L. The parties to insurance contracts can hold diverging subjective estimates of the moments of the distribution of L. How will such divergence affect the risk sharing solutions identified?

Suppose that there is divergence in expectations concerning the size of L. Consider first the SRT contract. If the insurer carries a higher subjective estimate of expected loss than the insured, the perceived price to the insured will be high relative to his estimate of the expected value of loss. If insurance is not a Giffen good (see for example Hoy and Robson [1981], Briys, Dionne and Eeckhoudt [1988]), this apparent increase in the premium will reduce the amount of insurance purchased. Thus, the absence of credible information on which to base loss expectations can lead to a contraction of the insurance market with loss of the potential benefits of risk sharing. However, if the insurers are more optimistic than the insureds, the effect will be reversed. This too could be dangerous if the optimism of the insurers turned out to be ill founded thereby leading them into financial stress.

In contrast, contracts designed on the DRT principle are less affected by differences concerning the distribution of L. Differences in expectations concerning the distribution of L between policyholders and external risk bearers, affect only the amount of dividend risk borne by policyholders. The premium plus dividend function defined by equation 6, depends only on the realization of L, not its expected value. Thus policyholders fully insure idiosyncratic risk regardless of the perceived price of transferring dividend. By retaining some dividend risk, each policyholder effectively insures against the risk of wealth

transfer from mis-estimating the distribution of L. This result is similar to the concept of "implicit mutual insurance" developed by Pauly, Kunreuther and Vaupel [1984] to examine public choices on self protection activities for independent risks.

## IV. CONTRACTING ALTERNATIVES AND HOMEMADE MUTUALIZATION

The SRT and the DRT may be assembled in various ways. The assembly of these contacts can involve different forms of corporate organization or, alternatively, both forms can be assembled simply by a stock insurer through appropriate policy design. A simple policy sold by a stock insurer with a prepaid premium and no policyholder dividend, would represent a SRT contract. In contrast, a policy sold by a mutual that did not reinsure, would allocate all dividend risk to the policyholders. If the mutual purchased reinsurance from a second stock insurer, then part of the dividend risk would be transferred to the shareholders of the reinsurance firm. The extent of reinsurance protection thus controls the level of $\beta$ in such a DRT. Reinsurance offers a secondary market for the dividend risk of mutual firms.

However, it is not necessary that a mutual type of organization sell the DRT contract. This was noted by Marshall [1974], in his comparison of the reserve and mutuality principles of insurance theory. He notes that stock firms might sell participating policies which, in his terminology, are referred to as "mutual contracts". Here, several possibilities are identified for assembling the DRT which cut across forms of organization.

1. Various forms of organization naturally assemble the DRT. In addition to the mutual type of insurer, the reciprocal, or unincorporated mutual, is functionally similar since here too the residual claims are held by the policyholders. Recent legislation, responding to the liability insurance "crisis" has promoted the

formation of similar structures. The Risk Retention Act (1986) permits the formation of risk retention groups that are subject to less severe regulation than other insurers. These firms issue inalienable stock to their policyholders and thereby resemble the mutual as discussed in Section V.

2. Stock insurers can assemble contracts that transfer an equity stake to the policyholder. One mechanism, most commonly used in life insurance, is the participating policy. The premium is subject to a retroactive adjustment that depends on the collective loss experience of the pool. This is simply a premium adjustment or a dividend. Though unusual in property liability insurance, such adjustments are sometimes encountered in workers' compensation insurance. A more widespread device that has similar, but not identical, effect is the "claims made policy" used in liability insurance. This also is discussed in Section V below.

3. The policyholder can, in principle, assemble the insurance and equity bundle on his own account. This is achieved by joint purchase of a SRT contract from a stock insurer, and the traded equity of that insurer. This is labelled "homemade mutualization". This idea is analogous to Modigliani and Miller's [1958], concept of "homemade leverage" and is valid only under comparable assumptions to those used by Modigliani and Miller. For example, taxes, contracting costs and agency costs may have different effects on the investment decisions of the stock and mutual firms that cannot be undone by homemade mutualization.

Homemade mutualization is illustrated as follows.[18] The individual jointly purchases a policy from a stock firm with a coinsurance proportion $\alpha$ together with some proportion, $\pi$, of the equity of the insurer. Given limited liability, and the limitations of the one period model, it is natural to think in terms of the insurer paying a non negative dividend;

$$\text{Dividend} = \pi[L^u - L]$$

The purchase price of this equity share will reflect the risk premium, R;

$$\text{Price of equity share} = \pi[L^u - E(L) - R]$$

These equity cash flows can be combined with the policy cash flows to replicate exactly the payoff structure for the DRT contract defined in equation 7. This can be seen by the following expression for payoff with homemade mutualization;

$$W - \alpha[(E(L)+R)/n - \pi(L^u-L) + \pi(L^u-E(L)-R)] - (1-\alpha)L_i$$

Re-arrangement and substitution of $\pi = (1-\beta)/n$ yields the payoffs shown in equation 7. The optimal solution is then identical to that shown in Figure 1 with $\alpha^*=1$ and $\beta^*=(1-n\pi^*)$. The other properties of the solution for the DRT also are preserved. In particular, the optimal solution for the insurance contract and for the share of the insurer's equity are one way separable, i.e. $\alpha^*=1$ whatever the value of $\pi^*$.

The preference for the DRT was based on the assumption that the risk falling on the insurer would command a risk premium. One explanation for such a risk premium given was that the risk was correlated with the portfolio of all assets, so called systematic risk. With this explanation, transaction costs are not central to the explanation of the dominance of the DRT, though of course some form of transaction cost was necessary to explain why insurance would exist in the first place. The second explanation for the risk premium related to firm specific costs of risk bearing. Here transaction costs are central to our results. To see this consider that the primary insurer might elect to reinsure its policies with a reinsurer. Reinsurers typically construct portfolios that are highly diversified. Thus while a primary insurer's results might be vulnerable to the effects of an earthquake, abnormal weather, expansion of liability rules, etc, the reinsurer often has a much wider spread of risk covering not only many different types of insurance, but which also is spread internationally. What is not diversifiable for the primary insurer might well be diversifiable for the reinsurer. Why don't primary insurers simply pass through the undiversifiable risk to the reinsurance market where it will not command a risk premium? Alternatively, why do reinsurers not operate in the primary insurance market? The answer lies in transaction costs to the

reinsurance contract.

Primary insurers and reinsurers have different firm specific capital. Primary insurers have a comparative advantage in marketing insurance and in underwriting individual risks. These insurers are subject to regulatory scrutiny with its associated costs in terms of constrained investment performance, regulatory filings, regulated rate of return in many states, etc. In contrast, reinsurers have a comparative advantage in evaluating catastrophic loss potential and in diversification across lines and territory. Further, reinsurers can avoid much of the cost of regulation by confining themselves to the secondary insurance market. Now primary insurers can avail themselves of the diversification capacity of the reinsurer by ceding part of their risk to the reinsurer; but such a transaction is costly. All the usual problems of moral hazard and adverse selection are present which will require that the reinsurer set up incentive compatible contracts and/or costly systems of monitoring the primary insurer's underwriting practices. In addition, there are other transaction costs such as search costs and simple administrative costs. Such costs will ultimately affect the price at which insurance is offered to the policyholder. Thus reinsurance will be used when the primary insurer is faced with correlated policies and the cost of bearing this risk internally exceeds the transaction cost for reinsurance.

## V. RISK BEARING, AGENCY COSTS AND CONTRACT CHOICE IN LIABILITY INSURANCE

The selection between SRT and DRT contracts carries implications for contract design and organization form. The analysis in section III suggests that, under the transaction cost assumptions used, the DRT contract would dominate the SRT. The implication would seem to be that SRT contracts would not

survive. Clearly, this is not the case. We now relax the transaction cost assumptions. Elsewhere, agency arguments have been evoked to explain the diversity of organizational form in insurance markets. We review these arguments and combine them with the risk bearing propositions developed above to provide a richer explanation of contracting choices in liability insurance markets.

With costless contacting, the Coase theorem [1960] implies that organization form is irrelevant. With costly contracting, specific organization forms will have survival value where the combination of agency costs and production technology permit them to offer products at lower prices than other forms of organization, (Fama and Jensen, [1983, a & b]). The agency costs include the costs of writing and monitoring incentive compatible contracts together with the value of lost output from incomplete enforcement. The insurance firm combines three basic functions, those of the policyholder, the manager and of the owner who supplies capital and bears the residual risk (Mayers and Smith, [1986, 1987]). While the stock form separates these functions, the mutual combines the policyholder and owner functions, so that policyholders also are residual claimants. The benefit from combining these functions lies in the removal of inefficiencies that can arise as shareholders attempt to extract wealth from policyholders after policies are written. Such wealth transfer might arise from a premature disbursement of the surplus, from an increase in the riskiness of investments, changes in reinsurance protection, etc.. These transfers are more likely to appear in long term contracts. The gain to mutual organization from the removal of policyholder stockholder conflict may come at a cost. For example, the mutual forgoes the advantages of specialized risk bearing and of capital market controls on managerial performance.

By matching available production technology with the different configurations of agency costs that arise across the three functions in different organizations, testable predictions are feasible. For example, mutuals will tend to prevail:

1. where the demands of insurance underwriting are fairly routine and require little managerial discretion such as life and automobile insurance, (Mayers and Smith, 1987)
2. where the policyholders are able to monitor managerial decisions at low cost. Examples are where policyholders possess relevant financial and technical skills or where the policyholders already have an independent forum for addressing common interests such as a trade association.
3. where the nature of the technology bestows advantages on long term contracting such as term or whole life insurance, (Mayers and Smith, 1986).

In contrast with the agency arguments, the risk bearing analysis of the previous sections asserts that, when risk are correlated, the payoff package offered by a DRT contract, that might inter alia be offered by a mutual firm, is preferred to that of a SRT contract that might be offered by a stock firm. The agency cost and risk bearing arguments yield joint predictions about insurance contracting and organizational choices. We address our remarks to the recent experience of the U.S. liability insurance market, commonly summarized as the "liability insurance crisis".

Priest [1987], Trebilcock [1987], Winter [1988], Doherty, Kleindorfer and Kunreuther [1988], and others have argued that the recent liability insurance crisis is due largely to correlations between policy payoffs caused by a destabilization of liability rules. To add background, liability insurance typically has been offered on an "occurrence" basis. Such policies cover occurrences arising within the policy year. Often losses are discovered, and claims filed, years or even decades after the policy was written. After suits are filed, negotiations and litigation often proceed for months or years before

final settlement is reached. These policies join the policyholder and insurer in a long term relationship. The delay exposes the firm to judicial, legislative and economic changes that commonly influence the ultimate determination of awards. For example, unexpected inflation over the runoff period could commonly increase the ultimate payoff on all outstanding claims beyond the amount reserved by the insurer. Similarly, a new judicial precedent or legislation can expand the area of liability, ease the burden of proof for future plaintiffs or cause a common upward shift in the value of awards on all outstanding claims. Such changes give rise to risk that cannot be diversified within the insurer's portfolio.[19]

The destabilization of liability rules has other agency cost implications. In addition to estimating loss distributions of proposed policies against a given liability standard, underwriters and managers must anticipate likely changes in the liability rules. Judicial and legislative instability also stresses different managerial tasks such as preparing legal defense to control claim costs and lobbying for legislative relief from unfavorable changes in liability rules. The added complexity of the managerial tasks increases the cost of managerial monitoring.

The above analysis suggests alternative responses to the destabilization of liability rules. First, existing stock insurance firms wishing to survive in the affected lines would rewrite their insurance policies to shorten the period of the relationship and to ensure that policyholders participate in the residual value of the insurer. This solution preserves the monitoring advantages of the stock form given the complexity of the decision problem but attempts to replicate the payoffs from a mutual policy. Second, new mutual forms of organization would emerge in those circumstances in which the policyholders are

well equipped to influence and monitor managerial decisions. Both responses have appeared and we discuss each innovation in turn.

(V.a) Contractual Innovations by Existing Stock Firms

Many existing liability insurers have introduced new policy forms that provide cover on a "claims made" basis. Though not universal, such forms are widespread in many liability lines. These policies cover only claims filed within the policy period, regardless of the timing of the occurrence that gave rise to the claim. The switch from "occurrence" to "claims made" has two pertinent effects. First, it reduces the period of the contractual relationship between insurer and insured. The insurer and insured can close their books on a "claims made" policy once the period of cover has expired and all claims filed in the period have been settled. This "shortening" of the contract reduces the scope for wealth expropriation by the shareholders from the policyholders and correspondingly reduces the disadvantages of the stock form of organization.

Second, under the "claims made" policy, the policyholder retains much of the undiversifiable risk arising from changing liability rules. Many liability suits are filed a considerable time after the occurrence and after the policy period has expired. The resolution of the claims reflects the liability rules in force at the time of resolution rather than the rules in force when the policy was written. The "occurrence" policy assigns the risk from such cumulative rule changes to the insurer. By shortening the period, the "claims made" transfers the risk of changing liability rules on the long latency period claims to the insured (see Doherty [1988]). Our analysis favors forms of contracting that assign this risk to the policyholder.

(V.b) The Emergence of "New Mutuals"

The second predicted innovation is that new "mutual like" firms would emerge where policyholders are able to monitor managerial performance at low cost. In fact, there has been a proliferation of such firms, most notably, the risk retention groups (RRG's). The RRG's are insurance pools that are established under the terms of the Liability Risk Retention Act of 1986. The Act facilitates the formation of pools of similar policyholders facing common liability insurance needs. The mutual nature of the RRG is ensured by requiring inalienable residual claims to be held by the policyholders. The restriction on alienability has conflicting effects. On the one hand, it permits the capture of the risk bearing advantages of the mutual type of contract. However, the restriction on alienability removes the secondary markets controls on management opportunism or incompetence. Such controls include hostile takeovers, stock option compensation packages, etc. (see Jensen and Meckling, [1979] and Easterbrook and Fischel [1981]). For example, in a recent examination of Alaskan Native Settlement Claims Act firms, Karpoff and Rice [1987] showed that restriction of the transfer of ownership was associated with markedly inferior financial performance. The removal of capital market controls would be especially severe for firms having a large number of financially unsophisticated owners without the benefit of independent organization (e.g. a trade or professional association). The composition of RRG's often is very different. For example, many pools cover the professional malpractice liability of lawyers, doctors and accountants. Such groups would be expected to display some technical and financial skills. Moreover, these groups are organized for collective pursuit of common interests through professional association. Other RRG's insure the personal liabilities of corporate directors and officers. Again we would expect this group to possess unusual monitoring skills. Still other RRG's insure the product liability, or pollution liability, of manufacturing firms. In many cases, the policyholders employ professionally qualified insurance managers,

which would lead us to expect intense monitoring of the management of the insurance pool.

(V.c) An Illustration: Medical Malpractice Insurance

The line of insurance in which these changes have been most completely documented is medical malpractice insurance. This market experienced a crisis during the mid 1970's. The crisis apparently reflected the belief that the legal environment in which these awards were made, had destabilized and that insurers were extremely vulnerable to this change in light of the long runoff period for their claims. The timing of the crisis followed an increase in the frequency and average severity of malpractice awards but also followed a decline in interest rates that would have reduced the insurer's investment income. A second crisis arose in the 1980's, this time extending beyond medical malpractice insurance to commercial liability insurance in general. The second crisis also followed a decline in interest rates and a continuing upward movement in the size and frequency of awards.

In response to these crises, policies were levied large premium increases and/or reductions in coverage and many large insurers left the market. But the crises also appear to have restructured the medical malpractice insurance industry. This has been pointed out by Danzon [1985b, p322]. Before 1975, the industry was dominated by large carriers writing group programs sponsored by the local medical societies. Now, more than 40% of the market is carried by the so called "bedpan mutuals". These are mutuals, reciprocals and RRG's that have emerged following the 1975 crisis. This probably substantially underestimates the degree of effective mutualization in this market. The successive crises have caused an unknown number of hospitals to self insure. Depending on the physicians' contracts with their hospitals these self insurance programs may

amount to mutual insurance. For example, if a physician owned HMO were to self insure, the aggregate burden of malpractice awards made would be fall dead weight on the equity shares of its physician owners. This is tantamount to mutual insurance. Finally, Danzon [1985.a] points out that the use of "claims made" policies by the surviving traditional carriers is almost universal practice.

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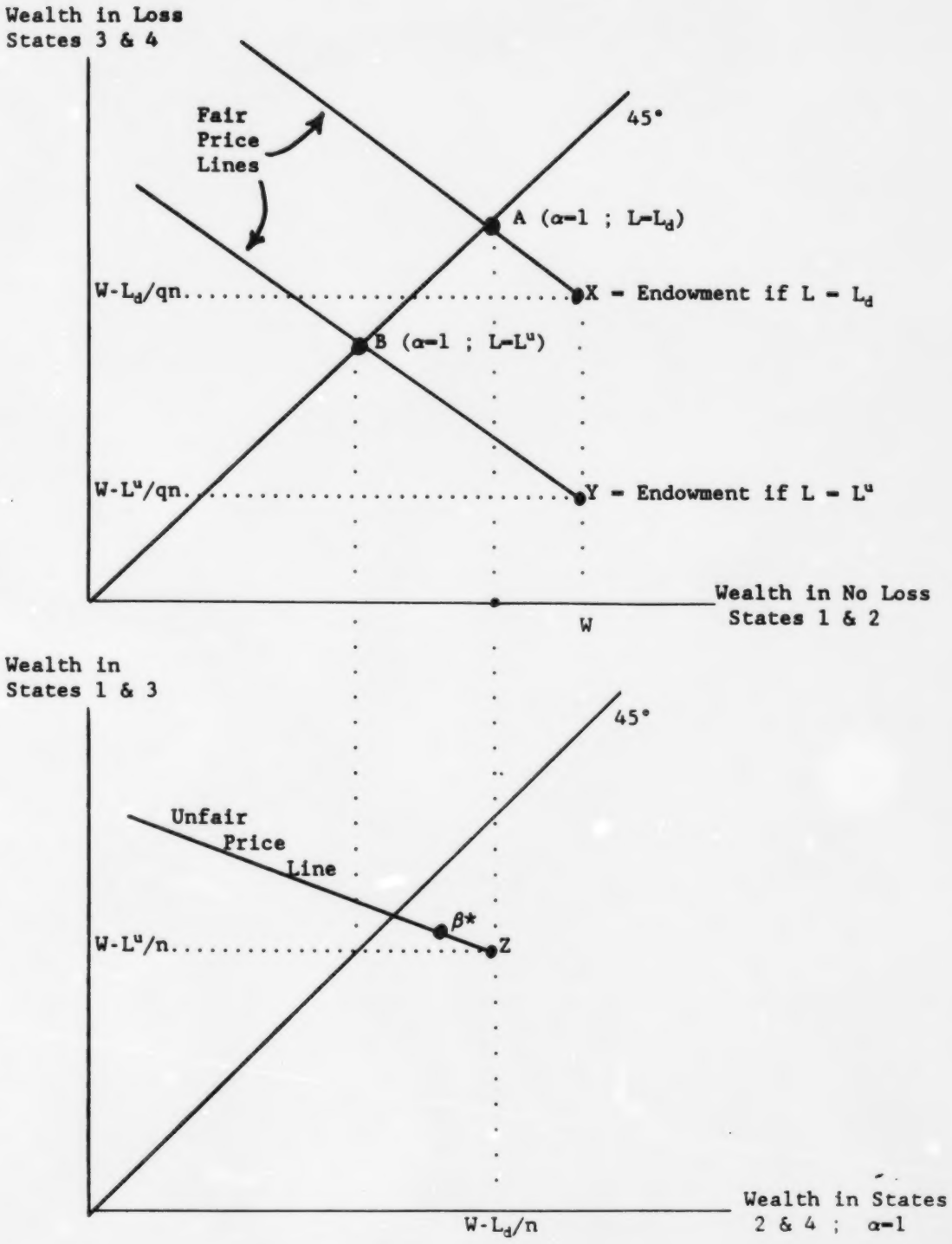
FIGURE 1




SEPARATION OF THE INSURANCE OF IDIOSYNCRATIC RISK
AND THE INSURANCE OF DIVIDEND RISK

FOOTNOTES

1.An insightful survey of issues in the particular troubled pollution insurance market is given in a recent report of the National Association of Insurance Commissioners, see Haayen [1983]. Of particular significance are the recent cases of mass torts and toxic torts (e.g. Dalcon Shield, asbestos, Bhopal, etc.) which challenge courts to create new, and perhaps radically innovative, liability rules. These innovations redefine cover, not only on current policies, but sometimes for policies issued years or decades earlier. Rabin [1987] discusses many of the legal implications.

2.Strict independence is sufficient, but not necessary, for the law of large numbers, see Marshall [1974] for more details.

3.Premium loadings to cover transaction costs are encountered in proportional and non proportional forms. Risk premiums to compensate external investors for assuming risk are central to the contract comparison. In footnote 11 below we show an example of such risk premium using the capital asset pricing model.

4.While it is possible to generate similar results to those in Section III without zero covariance between insurable and non insurable assets (proof available on request), this assumption allows us to separate the insurance decision from other portfolio decisions of the insured (see Mayers and Smith [1983]). An equivalent result may be derived for the class of risk averse, state independent, utility functions following Doherty and Schlesinger [1983].

5.See Fama and Jensen [1983] a, b; and Mayers and Smith [1986, 1987].

6.See Arrow [1963] and Raviv [1979].

7.e.g. Akerloff [1970], Marshall [1976], Dionne and Lasserre [1987].

8.If L is correlated with the aggregate wealth then "dividend risk" might be more conventionally labelled "social risk" or "aggregate risk", (see for example Allais [1953], Dreze, [1971]. However, we also consider the possibility that L is uncorrelated with aggregate wealth but, due to transaction costs, it is still costly for the insurer to bear this risk. The term dividend risk captures both cases and focusses on contractual choices for allocating this risk between policyholders and investors.

9.Some insurers cannot make negative dividends (assessments) under their terms of incorporation. Others, known as assessment mutuals, do not charge an advance premium but rely solely on a retroactive assessment to pay claims. If contracting is costly, a high advance

premium provides a way of bonding policyholders to fulfill their contracts, i.e. not to default on payment. This is consistent with the comparative rarity of assessment mutuals.

10.The allocation of the dividend risk in the DRT contract corresponds to a form of reinsurance contract that elsewhere has been shown to be Pareto optimal; see Buhlmann and Jewell [1979] and Raviv [1979]

11.The allocation of the risk premium across policyholders is illustrated as follows. Suppose, for example, the risk premium arose because total losses, L, were correlated with the market portfolio. The risk premium demanded by investors assuming the capital asset pricing model were appropriate, would be

$$\beta R = COV[\beta(L-L_d);\ R_m][E(R_m)-R_f]/VAR(R_M)$$

where $R_m$ is the return on the market portfolio and $R_f$ is the risk free rate. For each policyholder, the risk premium would be

$$COV[(\alpha/n)\beta(L-L_d);\ R_m][E(R_m)-R_f]/VAR(R_M) = (\alpha/n)\beta R$$

Notice that the risk premium paid by an individual increases with $\alpha$. Similar examples of increasing risk premia can be developed using other asset pricing models or using a firm specific cost of risk bearing to motivate the risk premium.

12.The pricing of systematic risk is explained in asset pricing models such as the capital asset pricing model, CAPM, and the arbitrage pricing theory. It will be noted that the riskiness in L is a necessary, but not a sufficient, condition for the presence of a risk premium with these models. Recent evidence of non zero underwriting betas is provided by Cummins and Harrington [1985]. Their results, derived using insurers' quarterly underwriting data, do however reveal some inter-temporal instability.

13.See Smith and Stultz [1985], Scholes and Wolfson [1987]. Alberts and Hite [1983] show how such imperfections (they specifically examine leverage related imperfections) affect product prices and quantities given competition in the product market.

14.A standard result in the contingent claims literature is that full insurance would be purchased in a complete market. However, our result is that only idiosyncratic risk is fully insured. The retention of dividend risk is incompatible with a complete market.

15.In fact, the SRT is a mean preserving spread of the DRT; a proof is available from the authors.

16.e.g. Arrow [1963], Mossin [1968], Smith [1968].

17.Exceptions to these results may arise (a) with random initial wealth, Doherty and Schlesinger [1983], Mayers and Smith [1983], and (b) when the insurer is subject to default risk, Dohérty and Schlesinger [1989].

18.Discussion of homemade mutualization requires a qualification of the assumptions. Separability of the demand for insurance from other portfolio decisions was achieved by assuming that the individual's insurable risk was independent of other items in his

wealth portfolio. The assumption of zero covariance between marketable and non marketable assets effectively rules out the individual taking a position in his insurer's stock when the payoff on the policy and the payoff on the insurer's stock are correlated. However, the point here is that homemade mutualization is a joint purchase of the policy and the insurer's equity has an identical payoff to the purchase of a policy from a mutual. Thus the assumption that the payoffs from buying a mutual policy are independent of background portfolio wealth is equivalent to assuming that the payoff to the homemade mutualization bundle is independent of the other marketable assets.

19.Examples of both judicial and legislative innovation that have had such effects are the "Jackson Township" case and the "Superfund" legislation. Both are claimed to have considerably expanded the liabilities of those involved in the manufacture or diposal of hazardous materials. See Doherty, Kleindorfer and Kunreuther, [1988].